Amendments to the Specification

Please replace paragraph [0054] with the following replacement paragraph:

[0054] By obtaining a time interval ratio for a laser beam passing across the sensor device 28, it is possible to calculate a passing position for each laser beam configuration. Accordingly an elevation angle for the Rover compared to the center line of the laser transmitter can be promptly calculated. Additional details for the exemplary laser transmission, detection, and analysis system is found in commonly assigned co-pending U.S. application Serial No. 10/732,145 filed on December 10, 2003 entitled WORKING POSITION MEASURING SYSTEM, and published as U.S. Patent Application Publication No. US 2004/0125365 on July 1, 2004, which is incorporated herein by reference.

Please replace paragraph [0055] with the following replacement paragraph:

[0055] Referring to Figs. 9A through 9J, it will be understood by those skilled in the art that various beam patterns and variations analogous to an N-shaped laser signal can be used as a basis for sensing multiple diverging laser beams and computing an elevation angle between a reference point on a Base station and a corresponding reference point on a Rover. Some of these patterns incorporate only two fan-shaped beams (see Figs. 9A-9B) while others incorporate three or more fan-shaped beams (see Figs. 9C-9J). Also, patterns incorporating curved or creased fan-shaped beams (see Figs. 9I-9J) can also be used. Exemplary techniques for detecting and computing elevation angles including the technique of using two separated light receiving sections in an optical sensor 28 for analyzing two selected fan-shaped beams are disclosed in commonly assigned co-pending U.S. application Serial No. 10/338,705 filed on January 9, 2003 entitled POSITION DETERMINING APPARATUS AND ROTARY LASER APPARATUS USED WITH THE SAME, and published as U.S.

Patent Application Publication No. US 2003/0136901 on July 24, 2003, which is incorporated herein by reference.

Please replace paragraph [0057] with the following replacement paragraph:

[0057] Accordingly for a known angle theta, the position of the antenna cannot be arbitrary. It must be found on a certain geometric surface. In other words, provided one knows the angle, only two degrees of freedoms are left instead of three to locate the antenna._ Actually all three components of the Rover antenna (to be more precise - correction δX to the rough position X_0 of the Rover antenna $X = X_0 + \delta X$) are always used as a part of the vector $\hat{Y}_k$ in equation (7) below. Restriction from three degrees of freedom to only two degrees of freedom is performed implicitly, applying penalty term (5) to the cost function (6) below. In any case whether or not penalty is applied (whether or not the system (7) or (1) is solved) the state vector $\hat{Y}_k$ or Y_k consists of x,y,z of correction δX, the time scales shift δt, and ambiguity.

Please replace paragraph [0060] with the following replacement paragraph:

[0060] The ambiguity resolution task generally comprises the following three main parts:

1. Generation of the floating ambiguity estimations (estimating the floating ambiguities) when additional geometry constraint is applied [[.]];
2. Generation of the integer ambiguities based in part on the floating ambiguity[[.]]; and
3. Formation of a signal of ambiguities resolution.

Please replace paragraph [0064] with the following replacement paragraph:

[0064] Let us divide the matrix D_k and the vector R_k in the equation (1) into blocks in accordance with division of the vector of unknowns Y_k into three parts:

$$D_k = \left(\begin{array}{c:c:c} D_{xx,k} & D_{xt,k} & D_{xn,k} \\ \hdashline D_{tx,k} & D_{tt,k} & D_{tn,k} \\ \hdashline D_{nx,k} & D_{nt,k} & D_{nn,k} \end{array}\right), \qquad R_k = \begin{pmatrix} R_{x,k} \\ R_{t,k} \\ R_{n,k} \end{pmatrix} \tag{3}$$

We will omit the epoch index $_k$ for the sake of brevity wherever this does not lead to misunderstanding. Given the vector h let $C_{\|}$ be the orthogonal projection onto the local horizon plane

$$C_{\|} = I - hh'$$

and

$$C_{\perp} = hh'$$

is the matrix of orthogonal projection onto the direction h which is the orthogonal complement to $C_{\|}$.

Provided there are no measurements errors, the identity

$$\left\|C_{\|}(X-T)\right\|\tan(\theta) = \left\|C_{\perp}(X-T)\right\|$$

must hold.

Expanding last identity obtain that

$$\varphi(X) = \left((X-T)'C_{\|}(X-T)\right)^{\frac{1}{2}}\tan(\theta) - h'(X-T) = 0. \tag{4}$$

Let also introduce the quadratic penalty cost function for violation of the equation (4):

$$\Phi(X) = \tfrac{1}{2}\varphi(X)^2. \tag{5}$$

Note now that solution of the equation (1) is equivalent to minimization of the quadratic function

$$\cancel{F(Y) = \tfrac{1}{2}\left\|(D_kY_k - R_k)\right\|^2 = \tfrac{1}{2}(D_kY_k - R_k)'(D_kY_k - R_k)}$$

$$\underline{F(Y) = \tfrac{1}{2}\left\|(D_k Y_k - R_k)\right\|^2 = \tfrac{1}{2}(D_k Y_k - R_k)'(D_k Y_k - R_k)}$$

The equalities (1) and (4) will be treated by least squares minimizing the 'penalized' cost function

$$P(Y) = F(Y) + w\Phi(X_0 + \delta X), \tag{6}$$

where w is the weight with which the equality (4) must be taken into account along with (1). Then the augmented scheme of estimating floating ambiguities comprising using the Laser Elevation Angle data in the numerical process will consist in making one or more Newton iterations to minimize the nonlinear function $P(Y)$ in (6). One Newton iteration takes the form

$$\hat{D}_k \hat{Y}_k = \hat{R}_k, \tag{7}$$

where the augmented matrix $\hat{D}_k$ and vector $\hat{R}_k$ take the form:

$$\hat{D}_k = \left(\begin{array}{c|c|c} D_{xx,k} + w\dfrac{\partial^2}{\partial X^2}\Phi(X_0) & D_{xt,k} & D_{xn,k} \\ \hline D_{tx,k} & D_{tt,k} & D_{tn,k} \\ \hline D_{nx,k} & D_{nt,k} & D_{nn,k} \end{array}\right), \quad \hat{R}_k = \begin{pmatrix} R_{x,k} - w\dfrac{\partial}{\partial X}\Phi(X_0) \\ R_{t,k} \\ R_{n,k} \end{pmatrix}. \tag{8}$$

Here

$$\frac{\partial^2}{\partial X^2}\Phi(X) = \frac{\partial}{\partial X}\varphi(X)\frac{\partial}{\partial X}\varphi(X)' + \frac{\varphi(X)\tan(\theta)}{\left((X-T)'C_{\|}(X-T)\right)^{\frac{1}{2}}}\left(C_{\|} - \frac{1}{(X-T)'C_{\|}(X-T)}C_{\|}(X-T)(X-T)'C_{\|}\right)$$

$$\cancel{\frac{\partial}{\partial X}\Phi(X) = \varphi(X)\left(\frac{\tan(\theta)}{\left((X-T)'C_{\|}(X-T)\right)^{\frac{1}{2}}} - h\right).}$$

$$\underline{\frac{\partial}{\partial X}\Phi(X) = \varphi(X)\left(\frac{\tan(\theta)}{\left((X-T)'C_{\|}(X-T)\right)^{\frac{1}{2}}}C_{\|}(X-T) - h\right).}$$